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A NEW CIRCLE TYPE CARBON DIOXIDE ABSORBER

BY

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OVER two years ago Messrs. Coxeter and Son Ltd. showed me an experimental model of a carbon dioxide absorber with ether vaporiser, possessing some interesting features, which were capable of improvement from the anæsthetist's point of view. As a result of our discussions certain essential requirements and other desirable, if not essential, features were agreed. In due course a new design based on this specification was produced and laboratory tests on an experimental model were made. These results were so encouraging that a clinical trial was made which confirmed in use the laboratory results.

The requirements agreed, the manner in which they were met, laboratory and clinical tests, are described below.

(A) ANÆSTHETIC REQUIREMENTS

1. The prime function of a carbon dioxide absorber is, of course, to absorb carbon dioxide from the patient's expira-

tions, and this absorption must be as great as possible so that the inspired gases shall contain a minimum quantity of carbon dioxide. Occasionally, however, it may be desirable to build up low concentrations of carbon dioxide in the gases, and for this purpose fractional absorption should be possible, i.e. the diversion of a portion only of the expired gases through the soda-lime.

2. It should have a soda-lime "cut-out" so that the soda-lime can be changed without opening the circuit, thus minimising the loss of valuable gas if such is being used, and avoiding alteration of the anæsthetic mixture, thus making for economy and smoothness of anæsthesia.

3. It should have a reservoir bag big enough to supply sufficient gas for the largest inspiration that a patient is likely to make.

4. The resistance to respiration should be as low as possible. This implies that the uni-directional valves must lift with the least difference of pressure so that the resistance offered by them shall be a minimum and that the path of the gases through the breathing tubes, and the ether and soda-lime chambers, is unrestricted.

5. An ether vaporiser should be incorporated in the circuit so that ether vapour can be added to the gases, if desired. This vaporiser should be of high efficiency, wickless, so that water-laden gauze is avoided, and so constructed that temperature drop is minimal.

6. The slightest movement of the bag should be easily visible, magnified, if possible, by mechanical transmission to an indicator. Any mechanism attached to the bag should be so balanced that no effort is required to fill the bag.

7. A mechanical method of compression of the bag should be available so that the patient's chest can be inflated at will, and controlled respiration be possible without undue fatigue on the part of the anæsthetist.

8. The whole apparatus should be gas tight so that at least leakage from the machine is eliminated.

9. There should be some audible means of knowing how far the controls are being turned when using the apparatus in a dark room.

10. The "dead" space should be minimal, i.e. the circle

should be brought as near the patient's lips as possible. This problem, though being attacked, has not yet been satisfactorily solved, and in the apparatus to be described the conventional method of attaching the two breathing tubes to a face piece or endotrachael catheter has been retained.

11. There should be a means of adding atmospheric air to the gases in the circuit.

12. There should be an expiratory valve on the machine which can either be completely closed or opened so as to work with a minimal difference of pressure.

13. There should be an inspiratory valve on the machine through which air can be inspired if the system becomes inadvertently empty, or deliberately should the anæsthetist desire the patient to do so.

14. There should be a means of indication of the time the soda-lime has been in use.

(B) Mechanical Requirements

1. The apparatus should be robust and able to withstand average wear in an operating theatre for a long period of time, without lowering its efficiency.

2. It should have as few joints as possible to eliminate gas leakage. As much as possible of the apparatus should be cast in one piece, and such joints as are necessary should be screwed or welded rather than taper jointed.

3. Moving drums should be gas tight and be easily removable for cleaning and lubrication.

4. Provision should be made for the drainage or removal of condensed water.

5. The controls should be clearly labelled and seen and be easy to work.

6. The apparatus should be as light in weight as is consistent with anæsthetic requirements and robustness. Unfortunately in time of war the choice of materials is limited, and lightness of weight has had to be subordinated to availability of material.

7. The minimum amount of rubber should be used in the apparatus, and wherever rubber is used it should be capable of easy replacement should it perish. By avoiding rubber,

gas loss by diffusion through this material—a most important and little appreciated fact—is minimised.

8. The valves should be, and remain, efficient for long periods of time. In the case of gravity valves, the valve itself should not warp.

(C) Chemical and Physical Requirements

1. The materials used in the construction of the absorber should not be liable to corrosion by ether, soda-lime, water, or any other chemical agent likely to be found in anæsthetic mixtures.

2. The ether vaporiser should be such that cooling of the ether is reduced as much as possible and water heaters avoided. Easy filling, wickless vaporisation and fine graduation of vapour are also desirable.

3. The clinical point of exhaustion of the soda-lime should be shown by some simple means, preferably visual. However, chemical endpoint and clinical endpoint do not coincide, and colour change detection for clinical soda-lime exhaustion is still in the experimental stage. The patient is still the most important guide to soda-lime exhaustion.

4. The whole apparatus should be earthed, and the tubing to the patient be conductive, to minimise explosion due to static electricity.

(D) Aesthetic Requirements

1. If it is at all possible, the apparatus, while conforming to all the above requirements, should by its symmetry and colour be pleasing to the eye and harmonise with the rest of the theatre furniture.

A recent effort to try and incorporate some of these requirements in an absorber was made by Frankis T. Evans (*Lancet*, 1938) whose admirable machine then represented a real advance in absorber design. However, his observations on the difference between single- and double-phase absorption in the circle type of machine have not been confirmed in experiments with this present machine. We, on the contrary, have found more efficient absorption to take place when both inspirations and expirations pass through the soda-lime.

The circle type absorber which will now be described was intended specifically to be attached to the table of the standard "Boyle" machine supplied by the Emergency Medical Service.

The Circuit

The circuit arrangement is as shown in Fig. 1. The patient's expirations pass through the soda-lime into the bag, and the gas which he inspires comes from the bag, back through the soda-lime, so that a "to and fro" system remote from the patient is employed, and the advantages of both the "to and fro" and the "circle" type absorber are retained. This type of circuit was experimented with by Frankis T. Evans (1938), but success was not, apparently, obtained. Evans found that though with single-phase absorption in his machine the CO_2 fell to 0.5 per cent or less, with double-phase absorption it rose to 4 per cent. In the present machine an

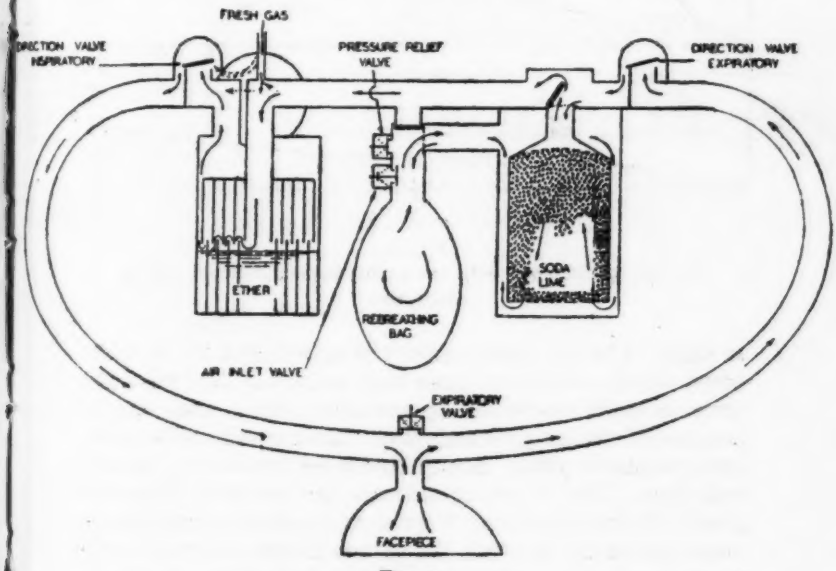

Fig. 1.

Circuit diagram. Soda-lime and ether both "on."

alternative drum was made which converted the circuit into the conventional single-phase system (i.e. one in which the expirations only pass through the soda-lime) and the carbon dioxide content of the inspired gases was estimated. The best figures were obtained when both inspirations and expirations passed through the soda-lime. (See Fig. 2.)

Soda-lime

The soda-lime (Wilson 4–8 mesh) is contained in a canister of almost standard dimensions (13.07 cm. × 7.4 cm.). It has a simple plug-in mount with a bayonet catch to lock the taper

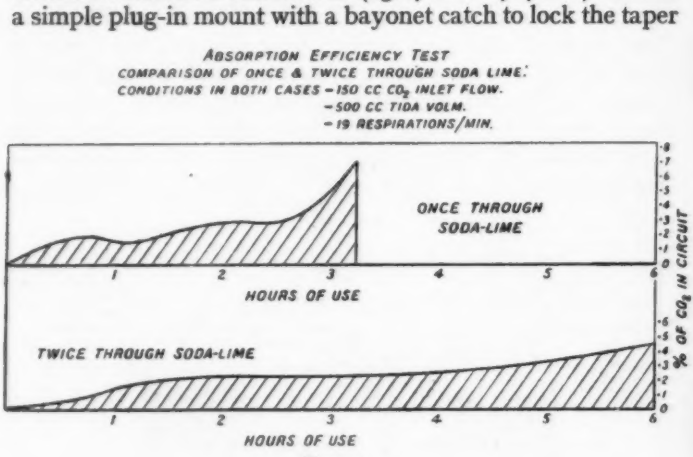
ABSORPTION EFFICIENCY TEST
COMPARISON OF ONCE & TWICE THROUGH SODA LIME.
CONDITIONS IN BOTH CASES – 150 CC CO_2 INLET FLOW.
– 500 CC TIDA VOLM.
– 19 RESPIRATIONS/MIN.
ONCE THROUGH SODA-LIME
HOURS OF USE
TWICE THROUGH SODA-LIME
HOURS OF USE
% OF CO_2 IN CIRCUIT

Fig. 2.

Absorption efficiency tests, comparing single and double phase absorption.

in place. The soda-lime canister is surrounded by an outer cover which conveys the gases back to the bag, and this outer cover is easily removable by swinging aside a sling for the purpose of changing the soda-lime. The capacity of the soda-lime canister is 568 cc. empty, and it holds 1 lb. (453 grams) soda-lime. The air space between the granules when the canister is full is 426 cc. A series of laboratory experiments were performed in which the carbon dioxide content of the gases near the face-piece was estimated when the circuit was used under a variety of conditions simulating those in clinical

practice. These experiments were stimulated by the excellent paper by Adriani and Rovenstine (*Anesthesiology*, Jan. 1941) to whom the author is much indebted. Two methods were used for estimating the carbon dioxide: a modified Orsat method with caustic potash as the absorbent, and

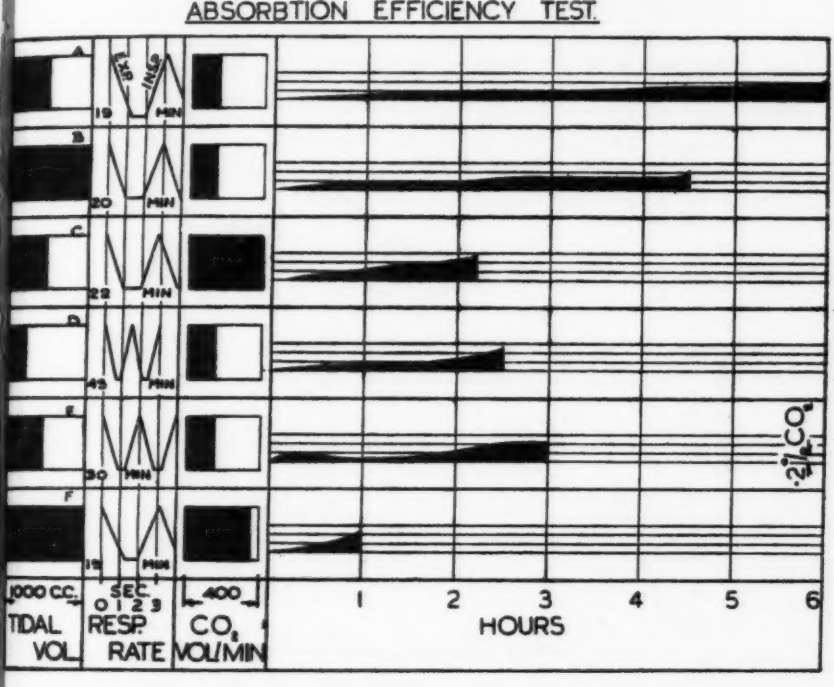

FIG. 3.

Absorption efficiency tests under variety of conditions.

Pettenkofer's method, using Baryta. Better absorption was obtained with double-phase absorption (i.e. inspirations and expirations passing through the soda-lime) than with single-phase absorption. The results obtained compared most favourably with those shown in Adriani and Rovenstine's paper, and are shown in Fig. 2 and Fig. 3.

Reservoir Bag

In order to allow of easy manual compression of the bag for the purpose of artificial respiration or controlled respiration, the bag is of concertina shape (Fig. 9). It is attached at one end to the body of the absorber, and at the other to a back plate, which is directly connected to a lever ending in a conveniently placed knob on the front of the machine. Depression of this knob compresses the bag with little effort on the part of the anæsthetist. The lever system is carefully

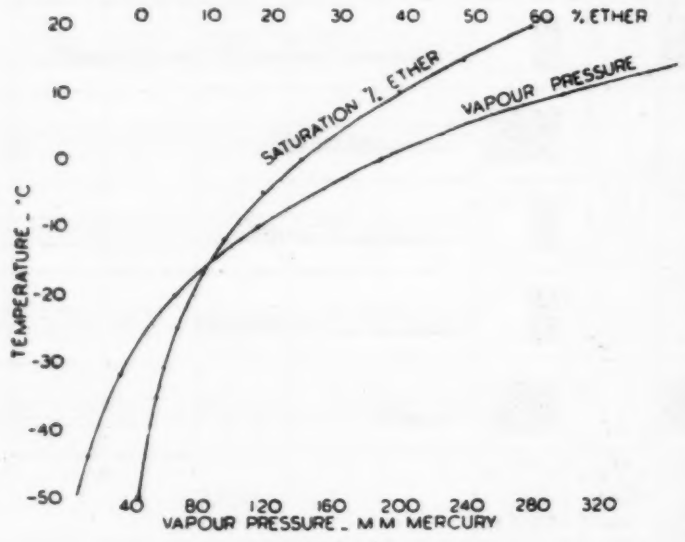

Fig. 4.

Ether saturation and vapour pressure curves.

balanced on ball bearings, so that the bag moves with the slightest respiratory effort. Each corrugation of the bag is stiffened by a wire ring, preventing collapse. The movement of the bag is transmitted to the knob, and can be watched from the front of the machine. The capacity of the bag without distension is 2½ litres, and is, therefore, large enough to supply the largest inspiration likely to be met with

in practice. Should the bag become defective, an emergency repair can be made by removing the concertina bag and plugging in an ordinary one-gallon thin rubber bag on a standard mount. (See Fig. 6.)

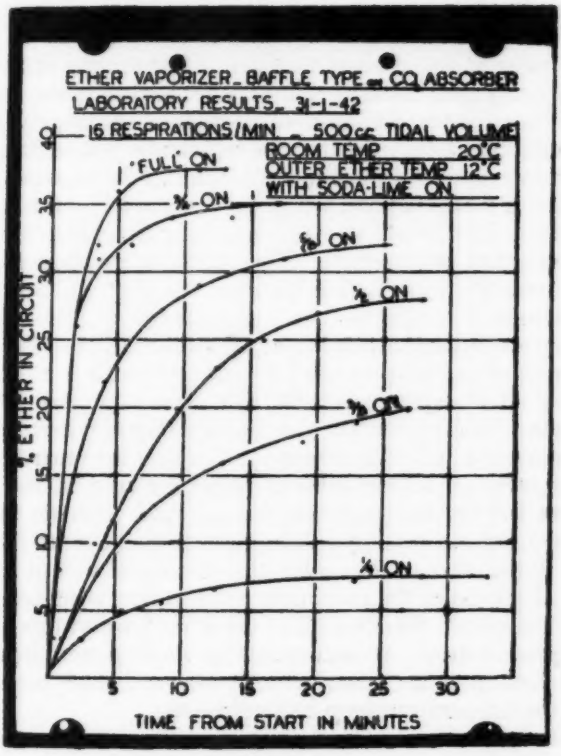

FIG. 5.
Curves of ether concentration.

ETHER VAPORISER

The main requirements of an ether vaporiser for a circle type absorber are:

(*a*) That the restriction to breathing is minimal.

(*b*) That ether can be added gradually to the circuit from a minimal amount, to at least a maximum sufficient for the deepest anæsthesia.

(*c*) That evaporation of ether is rapid, and that it is capable of maintaining the ether concentration in the circuit at a constant level for periods extending into hours.

In most of the present methods of vaporising ether, the gases are passed through or over ether-soaked gauze, which must be of some thickness to provide a sufficiently rapid evaporation. Not only may the resistance to breathing by this means be increased, but the gauze rapidly becomes saturated with water vapour, which is condensed as the temperature falls. This lowers its efficiency, and still further increases the resistance to breathing. Ether cools as it vaporises, and as it cools the vaporisation becomes less (Fig. 4). The ether containers in present use are usually made of glass—a poor conductor of heat, and when rapid vaporisation of the ether is required the temperature falls sharply, with a coincident falling off of vapour strength. The ether vaporiser fitted in this absorber has no wick, and the humidity of the circulating gases does not affect its efficiency. In order to ensure that the gases come in contact with the warmest part of the ether before leaving the vaporiser, evaporation is made to take place in successive stages. The gases impinge on to the surface of the ether at the centre of a concentric nest of baffles, and at this point the maximum evaporation takes place. It is at this point, therefore, that the ether temperature suffers the greatest drop. At each successive impingement less ether is picked up as the gases become more and more saturated, and the temperature drop is therefore less.

Finally, before leaving the vaporiser the gases come in contact with the outer layer of ether which, being in contact with the container (made of copper for maximum heat conduction), is maintained at room temperature.

The baffles, like the rest of the vaporiser, are made of copper, and they also act as heat conductors from the main body of the machine, and in the case of the second innermost baffle from the container itself, and therefore from the air of the theatre. In a room at 65°–70°F. (average operating

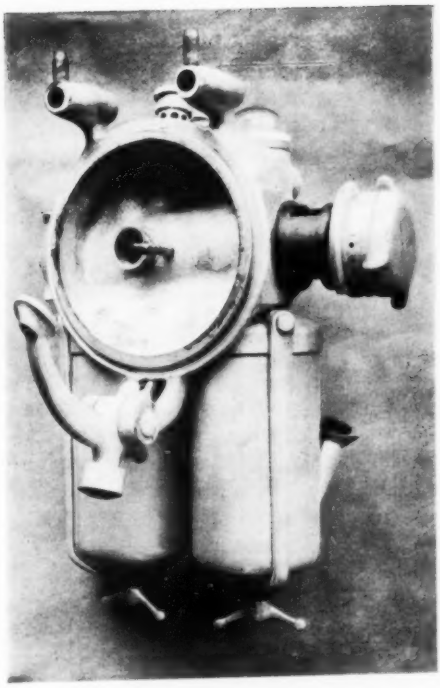

FIG. 6.
View of back of absorber with bag off.

W.W.M.

theatre) evaporation of the ether takes place very quickly in this vaporiser with only a slight drop in the temperature of the ether. This ether vaporiser thus overcomes the moisture difficulty, causes a negligible resistance to breathing, and allows a continuous evaporation of ether with little drop in temperature. The vaporiser was constructed so as to be symmetrical with the soda-lime canister in size. Being made of copper, it must have an indicator to show the amount of ether within. An ether level guage is fitted which indicates the ether level down to zero. The vessel should always be filled through the filler provided, which is so arranged that too much ether cannot be poured in (maximum amount is 13 fluid oz.). The ether concentration obtained and the degrees of control are well illustrated by the graph of experimental laboratory results shown in Fig. 5. In these experiments the gases were circulated from the apparatus into and out of a simple rubber bag. If there were no loss of ether from the system each curve should eventually rise to saturation percentage. Rubber, however, allows ether vapour to diffuse fairly freely, and as a consequence there is a continuous loss of ether from the system. The results, therefore, approximate to actual clinical conditions where, in addition to the loss through rubber, ether is lost by the patient through his skin and the operation wound. The method of removing the ether chamber from the machine for cleaning purposes is by swinging aside a sling in the same way as for the soda-lime canister. The ether vaporiser is fitted on the inspiratory side of the circuit. Turning off the ether diverts the basal O_2 flow from the machine side to the patient's side of the inspiratory directional valves. (See Fig. 10.)

Controls

The large, easily grasped control knobs for the ether and soda-lime are placed symmetrically on either side of the machine. These turn large drums which can be removed easily for cleansing and lubrication. Both the ether and the soda-lime can be used in a fractional manner, and a loud click is heard and felt at the $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ marks, so that indication other than visual is given to the anæsthetist. The main body of the machine, to which is attached the bag and the

ether and soda-lime chambers, is cast in one piece, with the channels for the rotating drums running through it. Mounted on this body are two glass domes through which the unidirectional valves can be seen. These valves are of the conventional gravity type; but being made of compressed fibre (Scolam) of half the density of aluminium they can be made thicker, and with less likelihood of warping, without increasing their weight. They can be renewed at negligible cost, and like the rest of the movable parts of the machine are easily detachable for servicing. These valves rest on knife edges. Although this arrangement might make it easier for gas to leak back past the valves, it was found that when the valve rested on a narrow ledge condensation of water soon made the valve stick a little with consequent increase in the pressure required to lift it.

The absorber as a whole slides on two runners fixed below

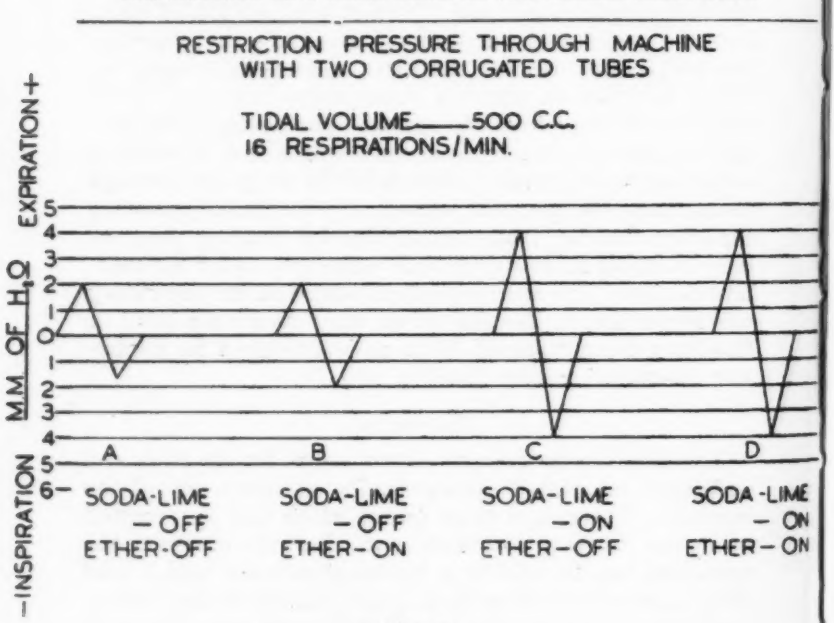

FIG. 7.
Restriction pressures.

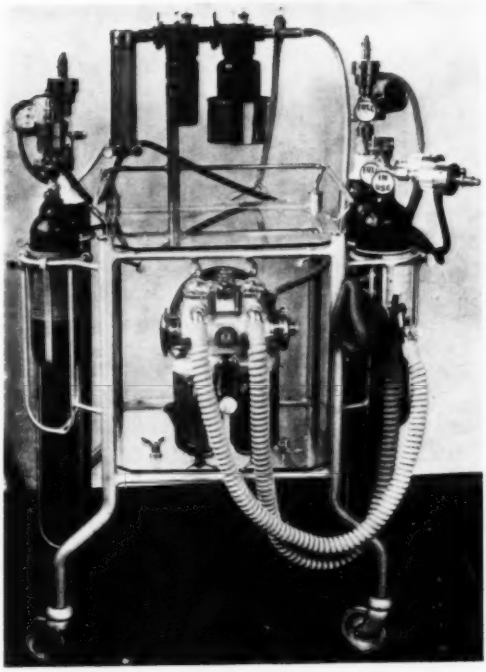

FIG. 8.
View of absorber *in situ* on standard Boyle machine.

W.W.M.

FIG. 9.
Side view of absorber.

W.W.M.

the top shelf of the standard table supplied with the Boyle apparatus (Fig. 8). This arrangement necessarily takes up a certain amount of the available space normally provided by the lower shelf. The mounting of the rails on which the absorber slides is by four thumb screws, and though in the ordinary course of events it will never be necessary, the whole absorber and its mounting can be removed very quickly. When not in use the absorber is pushed back so that it lies out of the way under the shelf of the table. The gas entry nipple is connected by means of rubber tubing to the flow meter and bottles outfit of the Boyle. The only rubber parts are the reservoir bag, the corrugated tubing and face piece, and the only taper joints are those at each end of the breathing tubes. The corrugated breathing tubes connecting the machine to the patient, the "Y" junction with the face piece, and the face piece itself, are all of conventional design, though their failings are fully appreciated. Active research in these matters is in progress.

Clinical Use

The absorber has had an extended trial for a large variety of surgical procedures, using cyclopropane, ether or trilene as the main agents. With the ether and soda-lime controls at the "off" position, the quantity of air in the machine is small, so that when starting anæsthesia the anæsthetic gases produce their effect rather more quickly than with most other absorbers. The knob fitted to the end of the expiratory bag lever moves with the slightest respiratory effort, and is occasionally seen to move synchronously with the heart beat when the patient is in apnoea. With the simple bag fitted on current E.M.S. absorbers, slight movements cannot always be seen. Here, every movement is transmitted to the lever, and is easily visible. The slings between which this lever moves have graduated marks on them, so that the excursions of the bag at one period in the anæsthesia can be compared with that at another period. Very light finger pressure on the knob is sufficient to inflate the average patient's chest, and artificial respiration and controlled respiration are easily performed. The ether vaporiser gives a very gradual increase in ether concentration from nothing up to a maximum of

about 38 per cent (laboratory figure). The clinical trial confirmed the laboratory findings with regard to ether vapour concentrations, in that the patient tended to stay in a level anæsthesia, varying in depth, for each position of the ether control, even though the control was left untouched for some time. This phenomenon is due to loss of ether through the rubber bag, and through the operation area and skin of the patient. The restriction to breathing was found to be 2 mm. of water with both soda-lime and ether off, and 4 mm. of water with both soda-lime and ether fully on (Fig. 7).

Temperature

Although the canister became quite hot to the hand, the temperature of the gases in the corrugated tubing next to the patient never rose above room temperature. No provision is made in this machine for the drainage of condensed water vapour since any that does accumulate is easily removed by dismantling the bag or the outer soda-lime cover. By avoiding drainage cocks (several of which would be necessary if the drainage is to be complete), more sources of leakage are eliminated. The presence of a little water in the machine does not interfere with its working.

To indicate the length of time that the soda-lime has been in use a small indicator has been fitted on to the soda-lime control knob. This time indicator can only be turned in one direction and should be moved by the anæsthetist at the end of each administration. This time indication, of course, is only of help when used in conjunction with the clinical signs of soda-lime exhaustion. These clinical evidences should never be ignored, and form the only reliable guide as to when a change of soda-lime is desirable. In any case, it is my own practice to rest a canister of soda-lime after each one-and-a-half to two hours of use.

An expiratory valve, which can be completely shut or opened so as to lift on very light pressure, is placed on the front of the machine. A valve in this position is convenient, since when the patient's head is in the operation field the bag can be emptied without fiddling with a valve under the towels. Symmetrical with this is an inspiratory valve through

which air can be inspired. Two gas entry nipples are mounted one on each side of the machine. One is for the basal oxygen, and the other, with a tap, for the introduction of air.

Several of my colleagues have given a clinical test to this absorber and for their helpful suggestions I am most grateful. They have confirmed my opinion that only as a result of collaboration between the manufacturer and the user can a real advance in the design of anæsthetic apparatus be made.

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CHLORALHYDRATE AS A PREMEDICATION FOR ANÆSTHESIA

BY

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HISTORICAL AND PHARMACOLOGICAL INTRODUCTION

PREVIOUS experience with chloralhydrate as a premedication for toxic thyroid cases and with cases for operation under local analgesia led us to believe that chloralhydrate might be usefully employed as a premedication with atropine before general anæsthesia. This belief was reinforced by a verbal account by E. S. Rawbotham of his experience with the drug.

Chloralhydrate was the first synthetic hypnotic to be used in medicine (Liebreich, 1869). For some years it was the only alternative hypnotic to opium and its derivatives apart from alcohol. It was also the first drug to be used as an intravenous anæsthetic (Oré, 1872[1]), and was used to prepare patients for operation as long ago as 1874 by Forné.

Lately it has been widely used, especially in midwifery, in combination with nembutal.[2, 3, 4] Little use, however, has been made of chloral in recent years as far as general anæsthesia is concerned, and no reference to it is found in the current British textbooks on anæsthetics except in connection with thyroid surgery and midwifery. The use of chloralhydrate has been neglected of late years because attention has been focused more on the modern hypnotics such as the barbiturates.

Chloral in dosages of 10 to 30 grains produces a natural type of sleep lasting 6 to 8 hours. This sleep is prevented by pain and lesser disturbances and there is no diminution of normal reflexes. These effects are due to a depression of the C.N.S. which first shows itself by a general diminution of objective perception, a diminished consciousness and so a tendency to sleep. Small doses diminish the normal movements produced by electrical excitation of the motor area of the brain, and large doses prevent any response to such stimulation. The medulla is the last part of the C.N.S. to be attacked. In moderate doses respiration is not more depressed than in normal sleep. There is some depression of the vasomotor centre which produces vasodilation. This is said to result in some cases in skin eruptions which, however, are not common. Chloral produces a fall of temperature partly by increased heat loss due to vasodilatation and partly by diminished heat production. Chloral in large doses has been shown in animals to have a direct action on the heart muscle which lessens the power of automatic contraction of the muscle. Death from chloral poisoning, however, almost always results from respiratory failure, though marked cardiac depression occurs as well.[5, 6]

While other effects of chloralhydrate have been investigated before, our attention has been drawn to its effect on the blood-pressure, especially as there is a widespread prejudice amongst the medical profession as to bad effects of chloralhydrate on the heart. Even among pharmacologists, however, opinion has turned in favour of chloralhydrate.[7, 8] H. H. Meyer mentions the effect of small doses of chloralhydrate on hypertension.[9] Gunn states that the therapeutic dose is considerably less than the depressant dose.[10] Clinically chloralhydrate has found an application even in the treatment of cardio-vascular diseases. J. Mackenzie recommended chloralhydrate as a hypnotic in circulatory disorders. Alstead used it for producing prolonged periods of rest (7 to 10 days with two doses of 10 grs. in daytime and one night dose of 20 grs.) in heart cases and reports favourably on his results.[11] Jaquet and Glaus treated sleeplessness in circulatory diseases with chloralhydrate with favourable results particularly in hypertensive cases.[12]

Experimental Part

The blood-pressure was taken in 125 soldier patients all of whom were E.N.T. cases admitted for operation. As premedication they were given chloralhydrate XXX grs. (ad. ½ oz. water) twice, the first dose being given in the evening before the operation, the second dose in the morning about 4 hours before the operation, leaving an interval of at least 8 hours between the two doses. Besides chloralhydrate per os they were given an injection of 1/100 or 3/200 gr. (in the later stage of the investigation) of atropine. Readings of the blood-pressure were taken at least twice: the first time soon after arrival in hospital, that is to say before any medication, the second time 3 hours after the second dose of chloralhydrate. A proportion of the cases was subjected to four blood-pressure readings: the first two being performed as mentioned above, the third 1 hour after the atropine injection and the fourth on the day after the operation.

Each blood-pressure reading consisted itself of three measurements by stethoscope according to American usage,[13] the first measurement being the point where the pulse sound reappears (systolic blood-pressure), the second one the point where the sound changes from a loud one to a weaker one and the third one the point where the sound disappears entirely. The judgment on rise or fall of the blood-pressure, however, has been based on the systolic blood-pressure only as experience has shown that this reading is the most reliable of the three, that is to say, the one which is almost free from subjective factors.

The main object of investigation was the comparison between blood-pressure reading 1 (before chloral) and blood-pressure reading 2 (after chloral). The distribution of the results is shown in Table 1.

Table I.

The Effect of Chloral on the Blood-pressure

(our results)

	Fall										Unchanged	Rise				
Mm. Hg.	5	10	15	20	25	30	35	40	45	50		5	10	15	20	25
Number of patients	17	17	22	21	10	11	5	2	3	2	4	4	3	2	0	1
Percentage of series	13.6	13.6	17.6	16.2	12.5	13.7	6.2	2.5	3.7	2.5	5.0	5.0	3.7	2.5	0.0	1.5

It is interesting to compare our results with those obtained by Alstead (1936) who investigated 55 cases (33 of whom had heart disorders.

TABLE II

THE EFFECT OF CHLORAL ON THE BLOOD-PRESSURE
(ALSTEAD'S RESULTS)

	FALL								UNCHANGED	RISE			
Mm. Hg.	5	10	15	20	25	30	35	40	—	5	10	15	30
Number of patients	14	5	2	1	2	1	2	1	4	4	6	2	1
Percentage of series	25.9	9.1	3.6	1.8	3.6	1.8	3.6	1.8	25.9	7.3	1.1	3.6	1.8

If we consider our series as a whole, chloral produces an average *fall* of the blood-pressure of 15.4 mm. Hg. (−4.0 mm. Hg. with Alstead). This average figure, however, is a bit misleading, as the group distribution shows a bigger effect in the direction of a fall of the blood-pressure. In 54 cases e.g. the fall amounts to 20 mm. Hg. or more. There is always a small percentage of cases (8.8 in our series, 23.7 in Alstead's) which respond to chloral with a rise of the blood-pressure, the cause of this individual reaction being unknown.

Our blood-pressure readings after the atropine injection led us to think that atropine counteracts the effect of the chloral to a certain degree by raising the blood-pressure again. In 45 cases in which the blood-pressure had been taken after atropine there was an average *rise* of the blood-pressure of 5.7 mm. Hg. The distribution of the cases, however, shows that 26 responded with a rise and 12 with a fall while 7 remained unchanged. If we take the 26 plus cases alone, the average rise amounted to 14.8 mm. Hg. In the later stages of the investigation (30 cases) we increased the amount of atropine to 3/200 gr., but the average rise of the blood-pressure was not greater than after 1/100 gr. of atropine. A control experiment was made with 8 soldiers outside our series who were given 3/200 gr. of atropine without any chloral. Only 4 of these cases showed a rise of the blood-pressure after 30 minutes. According to pharmacological experience atropine causes a slight rise of the blood-pressure.[5]

Blood-pressure readings on the day after operation were taken in 38 cases. In the majority (22 cases) the blood-pressure did not return to the level before the operation. It did return in 7 cases and went even higher in 9 cases.

The question can be raised whether the decrease in the blood-pressure is really due to the drug or to a night's rest or to other oscillations of the blood-pressure which usually occur even under normal circumstances, e.g. after mental stress. (An interesting experiment has recently been made in which civil defence workers were conditioned to air raid noises by producing them on records. Their blood-pressure rose by 15 mm. Hg. in the average.)[14] Five soldiers outside our series in whom a control reading of the blood-pressure was taken after a night's rest in hospital showed the following figures: −5, −10, +5, +0, −5, this indicates an average fall of 3 mm. Hg. It is, therefore, obvious that the effect of chloral exceeds the usual oscillations of the blood-pressure.

A further question was whether the decrease in the blood-pressure is accompanied by a fall in the pulse rate. Sixteen cases in whom the pulse rate was noted two hours after the second dose of chloral showed an average fall of the pulse rate of 6 beats. It could be questioned, finally, whether or not the slight increase in the blood-pressure produced by atropine was due to the fading out of the effect of the chloral. Some control experiments, however, showed that the effect of chloral on the blood-pressure is still traceable after many hours (6 to 8).

Clinical Observations

Our clinical observations were based on the study of a series of 162 soldiers undergoing general anæsthesia for ear, nose and throat operations controlled by a series of 132 soldiers undergoing operations of the same type by the same team in the previous four months who were given ¼ gr. of morphia and 1/100 gr. of atropine as premedication. The bulk of the operations were either submucous resections of the septum nasi or removals of tonsils by dissection. Chloral-hydrate causes the patients to fall asleep in about half an hour. The sleep is sound but the patients are easily roused and usually arrive awake in the anæsthetic room being then well

orientated and not at all anxious. The patients are more sensible and co-operative than after omnopon and scopolamine.

During the induction of anæsthesia (NO_2 and O_2 or open Ethylchloride) no respiratory depression was noticed so that induction was quick. Maintenance of anæsthesia was by intratracheal N_2O, O_2 and ether. Less ether was required than with morphia and atropine premedication. The pupils were larger at every stage of anæsthesia. The cough reflex returned promptly after operation but there was a tendency to restlessness which was controlled in the later cases by morphine gr. $\frac{1}{6}$ given immediately after operation.

As to postoperative complications there occurred a few cases (3 to 5 per cent) of bronchitis, local sepsis and secondary haemorrhage in both series, their number was slightly less in the chloral series. There were no cardiovascular complications at all and none of the other complications was serious.

Conclusions

Chloralhydrate premedication has the advantage of allaying anxiety without depressing respiration or delaying the return of the cough reflex, furthermore, it is reliable in its clinical effects. It reduces the amount of ether required, is cheap and easily obtainable.

As disadvantages must be mentioned its nasty taste (which can be mitigated by dilution and flavouring with synthetic lemon) and the occasional postoperative restlessness which can be controlled by a small injection of morphine (gr. $\frac{1}{6}$) immediately after the operation. This is the more advisable as chloral is not an analgesic.

Our experience with chloralhydrate leads us to believe that it deserves to be used more widely as a premedication.

Summary

In about 160 cases chloralhydrate with atropine proved to be a safe and satisfactory preoperative medication. Its main advantage is that it reduces fear without depressing the respiration or cough reflex. The effect of chloralhydrate on the

blood-pressure has been more closely studied and found to be far short of the danger line.

We wish to express our thanks to Dr. F. Pygott, Acting Medical Superintendent, for the helpful interest he has shown in this work.

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A LAYMAN'S ACCOUNT OF "GOING UNDER"

By D. I. Evans

Contributed by Dr. C. F. Hadfield

MOST people who have had an operation would, I think, regard going under the anæsthetic as the most interesting part of the whole business. It is certainly more pleasant than the process known as "coming round," for that journey back from oblivion is a dark and gloomy one. With the first sensation of the body's pain, there surges up from some lower region of darkness a desire to be dropped back into the merciful nothingness of a few moments ago. Across the murky dawn of consciousness prayers drift like phantom clouds. Curses shoot upwards and break the grey surface of the awakening mind, swirling there like ferocious fish. Slowly, through the mists, realisation breaks. He has been somewhere. Truer, he reflects bitterly, to say that he has been to the place called "nowhere," to oblivion, to Nirvana, the heaven of the Orientals. So these damned eastern devils practise their tortures even in the sacred courts of their gods! And so his groping mind stumbles on to collapse at length into a baffled stupor. But I am being led away from my theme.

I know nothing of "how the thing actually works." I cannot give an exact description of what happens to the body, nor what laws govern the behaviour of the mind as the world of our normal senses recedes farther and farther away. Previous to the actual experience I had fancifully compared it to what happens when the incoming tide invades the rocky shore. One by one the myriad little tunnels and crevices are filled. Farther and farther, deeper and deeper, the relentless flood penetrates, until it breaks at length into the last remaining stronghold of the mind, and then—oblivion. The actual thing was not at all like that. There was a swift and supremely dramatic climax that one does not associate with an incom-

ing tide. But in another sense the figure is appropriate. It does suggest something that went on for a fairly long time. When I was wheeled away to the theatre by a pair of white-robed attendants whom some grim humorist had christened "the body snatchers," a subtle influence was already at work knocking at the doors of my will. I had been given the usual preliminary dose of some drug. It was claimed for this that it had the power to send you to sleep. However, I was not asleep, but yet not fully aware. Lying on my back underneath what seemed a mountain of blankets, I reflected that now there was no escape. The die was cast. The course must be run.

My feelings in the little anteroom before they gave me the stuff are, I suppose, common to most. Once or twice a little wave of panic rippled across my mind. What if they started before I was completely under? What if I came round before they had finished? But by pinning my faith to the acknowledged skill of modern doctors, by remembering that countless others had come through without mishap, and by reminding myself that it was all for my own good, these fears were more or less successfully banished. The prevailing mood was one of idle curiosity—idle because the working of the drug prevented me taking a really intelligent interest in my surroundings. Lying on one's back gives only a very restricted range for the eye, but by turning my head to one side I saw that I had been brought close to a table whereon were laid the instruments of darkness. It was a cheerful enough sight—bottles of bright green and white, and among these the bright little servants of the surgeon's art; but here and there the rather sinister twist of brown tubing like the coils of a snake. Then a rubber strap was placed around my head or neck (or both) and a towering figure in white loomed over me. I heard him say, "Have you had this before?" I replied, "No sir." I remember wondering what he would have done or said if I had replied "Yes." The question seemed to me to be pointless. Perhaps he wanted to know whether I was "out" already with fright.

Then the rubber cap was fixed over my nose and mouth. Being too sleepy I did not hear the instructions to "close your eyes" and to "breathe naturally." However, to show them

that I was sensible and unafraid, I co-operated by doing these things of my own accord. A few seconds passed during which I seemed to concentrate on a certain buzzing and the gas pouring in. I remember congratulating myself on being still able to hear some words that were spoken. What they actually were I could not say. The longer I tried to disentangle their meaning the more confused they became. They ran into one another like some fantastic anagram of sound that got more and more beyond my power to solve. Then I lost interest in it. To remind them that my control had not yet completely faded away, and that I was not yet ready for the slab, I opened my eyes. A blurred, formless, white shape seemed to draw away from me suddenly. "Just in time," I thought. I was convinced that my timely action had prevented what would have been a very unhappy situation.

I find it difficult to convey to you my next reaction. It seemed as though my mind was being drawn out of my body and entering into that kind of existence it would have were it not housed in the flesh. It was as if the cables holding me to the earth were being untied, one by one, and, when the last was cut away, I rose, like a balloon set free, into the rarer levels of the air. I suppose that the nearest we ever get to this state in ordinary life is when we dream. But there is a difference. In dreams we recognise the sights, shapes, and sounds of our normal life, but in my experience I could not distinguish any of these things. Imagine a huge disc covered with concentric blue and white circles, like a huge firing target. Then think of this as revolving at great speed and retreating and advancing with uncanny regularity. There was nothing else. The whole field of the mind's vision was filled with those circles that sped away into the distance and dwindled to a mere point. Then, just when that remote speck seemed to vanish altogether, it would grow again and resolve itself into the same pattern, but this time racing towards me with incredible speed. Backwards, forwards, backwards, forwards. I remember marvelling at the smooth, effortless, regularity of it all. But I not only marvelled. I actually *thought*.

I remember my mind running along these lines. "Yes. This must be what they mean when they talk of 'another

plane of existence'—the plane of spirits who live by other laws than ours. I wonder what it would be like to live on one of these planes." A poetic phrase suggested itself to me and I found myself summing up the new situation in the words "unknown modes of being." Then came the strangest idea of all. These retreating and advancing circles suggested themselves to me as the final explanation of life. The eternal problems of both God and man were all resolved into this fantastically simple equation. Life, the whole of life, was nothing more than a process of becoming, growing, fading, dying (did not the behaviour of the circles prove it?)—a process that must go on and on to infinity with a perpetual motion conceived only in moments like these. There was about the whole thing a strange impersonal beauty—the perfection of a machine that can never falter or cease to function. I think that my mind registered a faint protest when I found life reduced in its last analysis to this infallible clockwork. What about the courage of human hearts, and the love of God? But no answer was forthcoming from those silent whirling circles.

Suddenly the circles began to revolve at a greater speed, and retreated and advanced with an ever-increasing momentum. Although the rhythm was accelerating it never strayed for an instant from its immaculate regularity, and the circles maintained their perfect symmetry. I thought of them now as a spring that was being wound and unwound, each time tighter than the last. I could see the inevitable end of this madness, and somewhere in my soul there must have been a great terror. Mercifully I was beyond its reach and viewed the approaching catastrophe with a calm detachment.

Then the very limit of speed and strain was reached, but at the very instant of the bursting of the spring I slid into a total eclipse.

I seem to recollect that for a fleeting second I imagined that spring to be the mainspring of the universe. Had I been given a vision of the end of all things, or, perhaps, of my own end? Intriguing questions, but who shall answer them?

The preceding graphic account was handed to me by a Lady House Surgeon at the E.M.S. Hospital at which I

work with the explanation that it had been written by a patient for his own amusement and given to her to read in case she should be interested. From internal evidence I guessed he belonged to the R.A.F. as it seemed likely that the advancing and receding circles of his vision were suggested by our well-known aeroplane markings.

I had, I found, anæsthetised him some days before for the performance of a simple operation, and the fact that I had no recollection of his case shows that the induction must have been quite smooth and uneventful. From my notes I see that he had nitrous oxide and oxygen with "Trilene," passing later to ether to obtain more complete relaxation. I have little doubt, however, that his mental experiences must have occurred during the former period as he would have been too deeply anæsthetised to remember anything before any ether was given.

Later I had a long talk with Mr. Evans and found that he was greatly interested by my suggestion that his essay should be printed. I also found that I was correct in my surmise that he belonged to the R.A.F., his present rank being "A.C.1." in that Service. He also informed me that he had never before written for publication and that, apart from his ordinary course as a student at Cardiff University and his civilian occupation as an English master in a Welsh secondary school, he had never done any literary work at all.

I was particularly interested in his description of how at a certain stage he reached a point at which the whole meaning of life was made not only plain, but simple and uncomplicated. This recalled to my mind a patient of my own whose experiences I have sometimes spoken of at anæsthetic meetings but never recorded in writing. Several years ago, on some two or three quite separate occasions, I was asked to administer nitrous oxide to a middle-aged gentleman for simple dental extractions in the usual manner. On each occasion as consciousness returned he waved his hand, almost jumped from the dental chair, and excitedly exclaimed "It's just like this . . ." and then no more. He would later explain that while he was unconscious the whole "Riddle of the Universe" had been solved and made abundantly clear. The mystery of life and death, of time and

eternity, of good and evil, of the future and the past, had been not only cleared away but interpreted in a manner as simple as it was entirely convincing. His first conscious desire was to announce it while it was still clear in his mind but before he could get out more than two or three words it vanished altogether from his recollection. If I remember correctly he told me that he went through exactly the same experience whenever he took gas (which he had had a good many times) so that his vision could not be ascribed to any peculiarity in my administrations!

This immediate fading of the dream experienced under short nitrous oxide anæsthesia is of course so common as to be almost universal. The importance of my case rests on the particular nature of the dream and the interest there would be if it could be retained and recorded—although it might, and probably would, turn out to be pure rubbish.

The consideration of these cases calls to my mind another story which although cognate is interesting as being in some ways their converse. In my Cambridge days and long before I had any interest in anæsthesia, I was well acquainted with an aged and retired minister of religion who was in fact the father of the headmaster of my old school. This reverend gentleman told me that on one occasion he had been given gas for a dental extraction. Details I have forgotten, if I ever knew them, but it is unlikely that it was a prolonged nasal gas as I do not think this method was practised in those days. On recovering consciousness he immediately asked how long he had been under the anæsthetic, and when told that it had been a matter of two or three minutes, he refused to believe it and was only convinced by reference to his own watch and other obvious evidences. The reason for this curious scepticism was that during these short moments he had, in his dream, lived through a period of two complete years. And in this case the dream, far from being forgotten, was still present in his mind in all its details. He had, in fact, later written out a long account of it which at the time I knew him he still possessed. I myself never saw it, for as I have said I was at that time in no way particularly interested in the subject. Another curious thing about this dream was that it had no connection with the events, scenes, and persons of his waking

life. He had dreamed that he was a village schoolmaster and he was able to describe the life and characteristics of the villagers and the course of events during the whole two years of his vision—years well marked, as he said, by the coming and return of two Springs, two Summers, two Autumns, and two Winters.

In most dreams, as Mr. Evans points out, "we recognise the sights, shapes, and sounds of our normal life," and he might have added some, at any rate, of the persons, but in his experience he could distinguish none of these things. The same was true of my aged friend's dream existence. The village in which he lived and the people he associated with there were fresh creations of his mind and altogether unconnected with any he had ever visited or met in actual life.

What does it all mean? Possibly something, much more probably nothing. Perhaps the psychologists can tell us. If they can I doubt very much if I shall believe them!

THE RECTAL ADMINISTRATION OF PENTOTHAL SODIUM

BY

A. R. HUNTER, M.D., D.A.

SOME eighteen months ago the author published in this journal an article describing the effects of the short acting barbiturates administered rectally. From the investigations then carried out it was concluded that Pentothal Sodium was too erratic in its action to be successfully employed as a rectal basal narcotic. Since the publication of the article in question the author's attention has been drawn to the work of Weinstein and Adams in whose hands Pentothal proved quite satisfactory for rectal injection. Lest the conclusions previously enunciated had been vitiated by the use of stale solutions it was thought desirable to repeat this part of the experiment with doses made up immediately before use. Each patient received 15 mgm. of Pentothal per pound of body weight; this is rather less than the amount recommended by Weinstein and Adams but experience with similar drugs has convinced the author that British patients respond well to doses smaller than those customarily given in America. The subjects of this experiment were adults, mostly females, who required tonsillectomy. In addition to the Pentothal each patient received 1/60th of a grain of atropine by hypodermic injection half an hour before operation; no preliminary opiate was administered.

The results were satisfactory though not perhaps quite so good as those with the sulphur free barbiturates. Of 21 patients 5 were asleep at the time of operation, i.e. one hour after the administration of the Pentothal. The remaining 16 were deeply under the influence of the drug and exhibited lack of emotional control, slurring of the speech and nystagmus. In short they appeared to be very "drunk." Two of the 21 patients were unduly pale and showed a certain

amount of diminution of the volume and force of the radial pulse. The degree of hypnosis produced was, however, remarkably uniform, having regard to the variability of action of Pentothal administered intravenously. Postoperative restlessness was encountered on three occasions but was never so violent as that sometimes met with after the use of sulphur-free barbiturates.

In general the rectal administration of Pentothal Sodium in a dosage of 15 mgm. per pound of body weight is a safe and satisfactory method of obtaining fairly deep basal narcosis.

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THE ASSOCIATION OF ANÆSTHETISTS, GREAT BRITAIN AND IRELAND

THE Annual General Meeting of the Association of Anæsthetists of Great Britain and Ireland was held at the premises of the Royal Society of Medicine, 1 Wimpole Street, W.1., at 2 p.m. on Wednesday, October 28th. The following Officers and Council were elected for the ensuing year:

President: Lt.-Col. Ashey Daly, D.A., R.A.M.C.
Vice-President: Dr. C. F. Hadfield, M.B.E.
Hon. Treasurer: Dr. Z. Mennell.
Hon. Secretary: Dr. A. D. Marston.

Council (12 members):

Provincial:	*London Area*:
Major. H. W. Featherstone, R.A.M.C.	Dr. J. Blomfield, O.B.E.
Air Commodore R. R. Mackintosh, R.A.F., V.R.	Dr. A. W. Matthew.
Major C. E. Sykes, R.A.M.C.	Dr. C. Langton Hewer.
Dr. R. J. Minnitt.	Dr. I. W. Magill.
Dr. J. Beckett.	Dr. R. Blair Gould.
	Dr. J. K. Haslar.
	Major V. Hall, R.A.M.C.

Six ordinary members were elected to the Association and Sir Francis Shipway, K.C.V.O., M.D. was elected an honorary member.

REFLEX CARDIAC INHIBITION UNDER GENERAL ANÆSTHESIA

BY

K. E. MADAN, M.D., D.A., D.O.M.S., F.I.C.A.

Lecturer in Anæsthesia, King Edward Medical College, Lahore, India

DURING an operation under general anæsthesia there may arise various conditions which can cause shock, and reflex cardiac inhibition. One of the causes which I have sometimes observed in my long experience and which has not so far been pointed out, is the therapeutic use of ether by the surgeon, by pouring it into the abdominal cavity in tuberculous diseases of the intestines, etc. Some surgeons of the old school seem to believe that the pouring of ether inside the abdominal cavity before its closure is beneficial to the tuberculous patient, as it is antiseptic, stimulant, and a solvent of the fatty capsule of Tubercle Bacilli. This is not really so, because instead of doing any good the ether inside the abdominal cavity might, as pointed out below, cause severe shock and even prove fatal. With the patient supine and the table in Trandelenburg position, the ether when poured into the peritoneal cavity gravitates upward to the diaphragm, due to the peritoneal watersheds, and thus shock at once takes place from sudden hyper-excitability of the vagus and of the solar and splanchnic plexuses.

Sometimes even half an ounce or more of ether is poured and left in the serous sac before the last one or two peritoneal stitches are applied to close it, and to ensure the ether remaining well inside the cavity the sensitive peritoneal edges are first pulled up with forceps and kept taut for suturing, which in itself causes some shock.

If the peritoneum is thickened from chronic fibrinous deposits, the shock is sometimes lessened.

Ether is very cold, irritating, and lowers the local resistance of the tissues to infection, and in the most sensitive and rapidly absorbing serous sac it sometimes sets up a dangerous reflex sufficient to cause reflex cardiac inhibition. This is particularly the case on a very hot summer day in the tropics when the body temperature remains sometimes even a little above normal, with no cooling system in the operation theatre, and in weak, exhausted patients with fever, the sudden intense cooling of the serous sac by pouring ether into it and thereby the sudden lowering of the temperature of the gut and the sac, has been definitely seen by me sometimes to suddenly produce grave shock, marked change in respiration, reflex muscular rigidity, and even death. The muscular rigidity is due to irritation of the lower intercostal nerves, the ramifications of which are present in the peritoneum. Death is due to fibrillation and reflex cardiac inhibition. This may happen in spite of atropine given as premedication to lessen vagal irritability. The ordinary means of resuscitation, injections, etc., are then of no avail.

As Crile rightly says, shock is felt by the brain even though the patient is under general anæsthesia, and particularly at the end of an operation when the peritoneum is nearly sutured, the anæsthesia is reduced, and so the patient is at this stage in a state of comparatively light anæsthesia. The tendency to reflex cardiac inhibition by over sensibility of the vagus is always high under light anæsthesia; it is higher with chloroform than ether, or nitrous oxide and oxygen.

The pouring of ether into the abdomen is, therefore, at times, the last straw that breaks the camel's back in a weak patient who has been exhausted by exploration and manipulation during a prolonged abdominal operation, with the added depression of an anæsthetic.

This grave complication from ether occurs late in the operation, so also it is well known that convulsions due to ether occur late in a long operation, when the patient is exhausted and has absorbed a big dose.

Just as irrigation and the injection of antiseptics in the pleural cavity have been given up due to the shock it

produces, so also the instillation of ether in the peritoneal cavity should be condemned, as it may prove dangerous as stated above. If at all ether is required to be poured into the peritoneal cavity, the amount should be very little, and the table should be in Fowler's position and never in Trendelenburg's.

SERVICE ANÆSTHETISTS

THE following list completes the names of those serving with the R.A.M.C. (the first list was in the Journal for July 1942).

We also append the names of Anæsthetists in the R.A.F.

Keates, Major G. H. W.
Keating, Captain J.
Kirk, Major R. S.

Lawrence, Major R. C.
Laycock, Captain J. D.
Leon, Lieut. K. W.
Lerman, Major L. N.
Lewis, Major W. H.
Linacre, Captain J. L.
Longthorne, Lieut. S. W.

Maidlow, Lieut. W. M.
Malion, Lieut. R. W.
Mark, Lieut. S.
Mellon, Captain E. R. R.
Moffat, Major J. O.
Milner, Major C. N.
Montgomerie, Major J.
Moore, Major R. H.
Morton, Major J. A.
Mountford, Major L. O.
Murphy, Major T. T. P.
Murray, Major J. L.
Murray, Captain W. H.
McCartney, Captain (Mrs.) E. M.
MacLaren, Lieut. H. C.
McConnell, Major W. S.
McCullough, Captain D. E. P.
McCoy, Major D. P.

Neill, Major H. G.
Neville-Jones, Major R.
Nicholson, Major J.
O'Hara Proud, Major F. R. P.
O'Neill, Major M. B.
Ord, Major J. W. E.
Overton, Major R. E.

Palmer, Major E. A. E.
Patrick, Major H. C.
Perrecles, Captain J. F.
Porteus, Major H. B.
Pleasance, Major R. E.
Porter, Captain N. C.

Quayle, Major G.
Quigley, Major T.

Rawlings, Major N. W.
Rea, Major S. B.
Redgate, Major J. W.
Rink, Major E. H.
Roberts, Captain (Miss) H.
Rochford, Captain J. D.
Rogerson, Captain H. L.
Ross, Major K. M.
Rowbotham, Major E. S.
Rowatt, Major J.

Saleh, Captain A. H.
Savage, Major J. M.
Schalit, Captain J.
Shaw, Captain R.
Shemelt, Captain P.
Shepphard, Major S. G.
Sington, Major H. S.
Shaceh, Captain M. R. E.

Stewart, Major C.
Swabey, Captain E. E.
Sykes, Major C. E.
Sykes, Major W. S.

Talbot, Major N. G.
Taylor, Captain J. H.
Tennent, Major R. A.
Thompson, Major O. S.
Thornton, Major H. L.
Thornton, Major K. B.
Toland, Captain C. P. K.
Torrance, Captain A. S.
Treevich, Major J. A.
Turner, Captain F. L.
Walter, Major W. J.
West, Major J. H.
Wevill, Major L. B.
Wilson, Major E. A.
Williams, Lieut. A. M.
Willis, Lieut. J. H.
Wilson, Captain J. S. H.
Winterbottom, Captain W. C.
Wood-Smith, Major F. G.
Wright, Major H. D. K.
Wyater, Major (Miss) T. M.
Wyse, Major H. D.

Anæsthetists in the R.A.F.
working as Anæsthetists in R.A.F. Hospitals.

Anson, S/Ldr. B. J. E.
Attwood, W/Cdr. J. H.
Brand, F/Lieut. T. M.
Dinnick, F/O. O. P.
Ebsworth, F/Lieut. J. D.
Edwards, F/Lieut. H. V.
Fraser, S/Ldr. A. C.
Gray, S/Ldr. G.
Graham, F/Lieut. John
Heyworth, F/Lieut. P. S. A.
Hindmarsh, F/Lieut. J. R.
Hughes, F/O. T. H.
Lucas, S/Ldr. B. G. B.
Osbourne, S/Ldr. S. E.
Panton, F/O. G. F.
Pickup, F/O. J. D.
Pooler, S/Ldr. H. E.
Rose, S/Ldr. G. M.
Rickards, F/Lieut. J. F.
Reid, F/Lieut. C.
Smith, S/Ldr. W. J. A.
Stoneham, F/O. F. J. R.
Skinner, F/O. E. G. F.
Soper, S/Ldr. R. L.
Thomas, F/O. K. B.
Wilson, F/O. H. Bruce

Anæsthetists in the R.A.F. who hold the D.A.
but are at present doing work other than Anæsthesia.

Crawford, F/Lieut. J.
Evans, S/Ldr. W. E. F.
Harvey, S/Ldr. H. F.
Jenkins, S/Ldr. C. R.
Pask, F/O. E. A.

ABSTRACTS

"Effect of Desoxycorticosterone Acetate in Post-operative Shock." KOSTER and KAGMAN in *Archives of Surgery*, Vol. 45, No. 2, p. 2724.

FROM clinical, pathological and experimental data the authors believed that adrenocortical substances should have value in the prevention or the treatment of shock. It has been held also that failure of the adrenal glands precipitates a state of shock. The authors' observations reported in this article were all made on patients operated on under spinal anæsthesia. There were 200 patients and the value of any addition to the therapy ordinarily employed should be reflected, it is stated, in the mortality rate. If desoxycorticosterone acetate could do anything to prevent death, these patients, all suffering from grave lesions, would offer it a fine chance to demonstrate its usefulness. The authors came to the conclusion on analysis of their results, that there was no evidence that the therapy prevented or favourably influenced shock.

"Pre-operative and Post-operative Medication." M. D. LEIGH *in Canadian Medical Association Journal*, August, p. 150.

To obtain the greatest benefit from pre-operative medication the anæsthetist should consider (1) desired effects, (2) available drugs to produce these, (3) dosage, (4) time and method of administration. The desired effects are, firstly, a quiet and comfortable patient without apprehension of the operation or anæsthetic, and, secondly, reduction of toxicity from the latter. Medication increases the amount of oxygen which can be supplied with nitrous oxide and ethylene. It protects against excitement and convulsion from local anæsthetics. Two main groups of drugs bring about the desired effects. First are the opiates, morphine, codeine, dilaudid and others and evipan and pentothal. These, besides producing a state akin to sleep, have good analgesic properties. The

other group are purely hypnotics, nembutal, seconal, avertin, paraldehyde and others.

As to time there is some latitude. When nitrous oxide or an intravenous barbiturate is the anæsthetic it is best to take advantage of the maximum analgesic property of the opiates. This is generally reached after one to one-and-a-half hours. Intravenously the opiates have maximum effect in twenty minutes. Chloralhydrate by the mouth and paraldehyde and avertin rectally, reach their peak hypnotic effect in about half an hour.

Two post-operative conditions call for a sedative, pain and restlessness. It must be remembered, however, that the pre-operative dose is probably still acting to some extent.

"*Ether, the All-purpose Anæsthetic.*" D. G. REVELL Jun., *Canadian Medical Association Journal*, September 1942, p. 235.

The author is mainly concerned with the importance of heat factors in ether anæsthesia. He describes original apparatus for delivering moist, warm, ether vapour. The thermal energy necessary for vaporisation of ether on a mask is borrowed from the inhaled and exhaled atmosphere passing through the ether-wetted covering of the mask. Most of this heat debt has to be made good by the mucosa of the upper respiratory tract, which in turn depletes the body heat. The normal function of the upper respiratory tract includes warming and moistening inhaled atmosphere so that the alveolar epithelium may carry on gaseous exchange under optimum temperature and humidity conditions. Therefore we should avoid routine or unnecessary use of pharyngeal or endotracheal airways and tubes during drop ether technique. To facilitate even administration of ether in the semi-open technique, Revell has devised an ether dripper which may be attached to the mask and adjusted to deliver ether at the desired rate. The generation of ether vapour at a short distance from the patient for any insufflation technique raises the problem of adequate and controllable heat to carry on the volatilisation. The author devised an apparatus which supplies ether vapour of any desired concentration almost

indefinitely. The essential principle involved is the vaporisation of liquid ether right in water in a closed container which is automatically kept at a temperature slightly above the boiling point of ethyl ether.

"Blood-pressure During Spinal Anæsthesia." HARRY KOSTER in *Archives of Surgery*, October 1942, p. 597.

The author reviews the literature of the subject and then relates his experience with persons who had received a spinal injection but had not yet been operated on. The blood-pressure of these people was studied before and during spinal anæsthesia under three sets of conditions. The conclusions at which Koster arrived were: (1) there is approximately the same percentage drop in systolic and diastolic pressure during spinal anæsthesia in patients not subjected to operation.

(2) The development of hypotension following the induction of spinal anæsthesia in patients with the extremities supported by elastic bandages, or in the extreme Trendelenburg position, is evidence against veno-dilatation as the cause of the fall in blood-pressure.

(3) The decreased blood-pressure indicates a decrease in cardiac output. This is a factor but probably not the only one responsible for the hypotension of spinal anæsthesia.

"Control of Pain in War Surgery." Bulletin of War Medicine, December 1942, p. 211.

Holle says first choice for almost all patients in front-line surgery is scopolamine-eukodal-ephetonin given by intravenous injection. Eukodal is a substitute for morphine, with formula $C_8H_2NO{\cdot}HCl$, and ephetonin is a blood-pressure raiser of the ephedrine type.

The drugs are provided in two strengths:

Scopol.	0.0005 and 0.001 grm.
Eukodal	0.01 and 0.02 grm.
Ephetonin	0.025 and 0.05 grm.

For war patients the stronger combination is generally desirable. The injection quickly brings on a condition of profound "twilight sleep."

Many surgical procedures can be carried out without any other anæsthetic agent but when one is needed ether should be chosen as the injection acts as an admirable basal narcotic.

"*Refrigeration Anæsthesia.*" L. W. CROSSMAN, F. M. ALLEN and others in *Anæsthesia and Analgesia*, October 1942, p. 241.

The authors first discuss the effect of local asphyxia as produced by a tourniquet and show that at ordinary temperatures a limb can survive without necrosis 12 to 15 hours complete deprivation of blood. Local temperature enormously influences the effect of a tourniquet. Elevation of temperature accelerates gangrene in a bloodless limb. Contrarywise the influence of lowered temperatures is illustrated in the preservation of living tissue in an ice-box. Lives can be saved by using cracked ice, snow ice or ice water as the only means of anæsthesia for amputation in feeble subjects, e.g. those with gangrene who are old, underfed and discouraged. No drug is needed as an aid to anæsthesia but a strong sedative is given. The technique is described and highly successful results claimed. Patients apparently inoperable were successfully subjected to amputations under refrigeration anæsthesia and recovered after amputation. The anæsthesia lasts about one hour. The stump is surrounded by ice-bags for 2 or 3 days. The authors claim that they work with anæsthesia of protoplasm in contrast with the usual anæsthesia of nerves only.

THE DIPLOMA IN ANÆSTHETICS

(Royal College of Surgeons and Royal College of Physicians)

THE following are the names of the candidates successful at the last November examination for the D.A.

E. H. Ainslie, Evelyn J. Attkins, L. B. Bourne, Albert Christie, P. J. De Vescovi, James Elliott, G. A. Hart, J. A. G. Horton, Brenda G. Hutchinson, I. R. Jones, H. G. Kahlenberg, Isabelle G. Little, Florence M. McClelland, Margaret McClelland, T. F. Miles, Dorothy S. Price, E. N. Price, Shila G. Ransom, Alice C. Rose, J. B. Scarr, Thomas Sim, A. D. H. Simpson, Dorothy Spence-Sales, R. J. Stout, C. G. Townsend, J. T. Worsfold and Jean R. Young.

REVIEWS

"Fundamentals of Anæsthesia": An Outline, by The Subcommittee on Anæsthesia of National Research Council. Published by American Medical Association Press, Chicago. 216 pp.

THIS book has been written primarily to serve as a basis for the instruction of Medical Officers in the Armed Forces of the U.S.A. in anæsthesia.

In explaining this fact the authors state that they have emphasised the principles of safety governing the administration of depressant drugs and the care of patients suffering from circulatory or respiratory depression, and have attempted to dwell on principles at the expense of detail.

This work contains a most comprehensive description of all types of anæsthetic agents and their modes of administration, and includes many excellent diagrams and illustrations, and a novel way of emphasising any special point by printing a phrase in large type at the foot of the page where it may readily catch the eye of the reader.

One chapter of particular interest contains a concise account of the signs, symptoms and treatment of special poisons—including war gases.

Transfusion of blood, plasma or serum, a treatment which was responsible for saving the lives of many war casualties in this country, has been very briefly mentioned. This is unfortunate, but doubtless must be attributed to the fact that the authors have had little experience of this treatment during the present war.

There is a full, clear description of local and reginal anæsthesia and the recent increased popularity of this technique for civilian and war casualties makes this section with its excellent diagrams of unusual interest. The subject of spinal anæsthesia has not received the same full attention, and one learns little of value from the brief note on this subject.

This work is undoubtedly of great value as a book of